II. Remarks

Reconsideration and allowance of the subject application are respectfully requested.

Claims 42-57 are pending in the application. Claims 42 and 52 are independent.

Claims 17-41 were rejected under 35 USC § 103(a), as being unpatentable over Arai and Louwagie, for the reasons noted at page 3 of the Office Action. Applicants respectfully traverse all art rejections for the reasons set forth in the June 21, 2004 Amendment.

Each of independent Claims 42 and 52 recites an novel, non-obvious combination of structure and/or steps whereby method and apparatus are provided for improved control of a hydraulic actuator in a machine that makes use of a distributed processing control architecture and a centralized system control processor. The system control processor performs the overall process control for the injection molding machine. The microcontroller, on the other hand, is preferably disposed adjacent the hydraulic manifold, the actuator, or the control valve, and is configured to execute control programs that correct, on a local basis, the valve control signals to account for certain non-linearity in the hydraulic actuators. This requires that the microcontroller know something about the dynamics of the hydraulic actuator and/or hydraulic control valve, and accordingly the microprocessor includes a memory that is configured to store the relevant

operational characteristics. This is described in relation to FIG. 2 and the accompanying text, especially:

paragraph [0034]:

> The local control of the manifold sub-system thus enables factory calibration and performance characteristic curves for every individual device to be stored in the memory of the on-board microcontroller. This allows additional fine-tuning of the local sub-systems by advanced control strategies and algorithms which, for example, may linearize the feedback from the measurements of the transducers and the control elements.

paragraph [0037]:

> The microcontroller 210 is in close proximity (e.g. within one meter) to the manifold 202 to control the operations of the valve 14, and thus the actuator 2.

paragraph [0038]:

> The microcontroller 210 may also receive feedback signals from other system sensors which monitor various operational characteristics of the hydraulic actuators to be controlled by the microcontroller. Accordingly, the microcontroller 210 can execute closed-loop control of the actuator 2 through control of the valve 14. In particular, the microcontroller 210 has a ROM (not shown) and a RAM (also not shown) which store one or more control programs which the microcontroller 210 executes to control the solenoid drivers 146, 148 of the valve 14. Since the microcontroller 210 contains all necessary programs and receives all necessary feedback, control can be executed without reference to the system control processor 216.

Claim 42 therefore recites the requirements for a

distributed control architecture with the added limitation, over Arai and Louwagie, that the memory of the microcontroller store operational characteristics relating to the actuator and/or valve that the control program then uses to correct the valve control signals.

The present invention also contemplates (see new Claims 44 and 47) an apparatus for profiling the pressure or flow of the hydraulic fluid into and out of the hydraulic actuator to achieve optimum valve response. The valve configuration is unique in that the fluid flow to the opposing chambers in the actuator is controlled by separate control valves. As the coordination and control of these valves is quite complex, a distributed processing control architecture is again used, whereby the control is performed but the local microcontroller that avoids processing overhead in the system controller. Support for new Claims 44 and 47 can be found in:

paragraph [0047]

> By providing increased processing power adjacent the hydraulic manifold, it is possible to compensate for the non-linear characteristics of each hydraulic actuator to ensure reliable operation. The microcontroller 210 can store a control program which compensates for such non-linear characteristic and ensures linear control of the valve. Referring to Diagram A below, the compensation method according to the present invention will compensate for the main non-linearity f by an approximate inverse function f^{-1}, which can be implemented in the controller.

paragraph [0073]

> A solution to this problem ([0072]...there is currently no way to adjust the ratio of the valve opening after the system is constructed) is to use two three way (P, T, and A) proportional (servo) valves (Figure 7, valve 72 and valve 74). These valves in conjunction with pressure transducers 66, 76, 86, and 96 in the P, T, and A ports of the valves 72, 74 allow profiling the pressure or flow into and out of the actuator cylinder (this could also be a rotary actuator).

paragraph [0076]

> This embodiment can seamlessly adjust the orifice metering in and/or metering out hydraulic fluid (oil) from each side of the cylinder independent of what the other valve is doing.

For the reasons set forth in the June 21, 2004 Amendment, Applicants again wish to point out that the combination of Arai and Louwagie is improper. Even if combined, Louwagie does not remedy all of the deficiencies of Arai in addressing the problems solved by the present invention. In particular, Arai does not address a solution to the problems of how to configure a control architecture for an injection molding machine with improved timing control, a more robust architecture, accounting for non-linear characteristics of a hydraulic actuator, and profiling the pressure or flow of the hydraulic fluid into and out of the hydraulic actuator to achieve optimum valve response. Louwagie does not remedy the deficiency of Arai

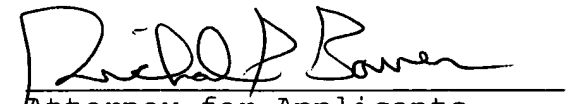
for arriving at the claimed invention. In particular, neither Arai or Louwagie suggests a method or apparatus for controlling an injection molding machine wherein the microcontroller memory stores operating characteristics of at least one of the hydraulic control valve and the hydraulic actuator, the operating characteristics usable locally by the microcontroller and in the control program to generate control signals that affect closed-loop control of said hydraulic actuator (e.g. flow rate linearization). In addition, neither Arai or Louwagie suggests using a first and second proportional valves for controlling the flow of hydraulic fluid to the hydraulic actuator, using pressure feedback from the first and second proportional valves, to provide regenerative and non-regenerative control of said hydraulic actuator to effect profiling of the pressure or flow the hydraulic actuator.

Accordingly, the salient claimed features of the present invention are nowhere disclosed or suggested by the cited art, whether that art is taken individually or in combination.

In view of the above remarks, it is believed that this application is now in condition for allowance, and a Notice thereof is respectfully requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 625-3507. All correspondence should continue to be directed to our address given below.

Respectfully submitted,



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